

**Environmental Classification:** This is a category III project according to the IIC's environmental and labor review procedure because specific impacts may result that can be avoided or mitigated by adhering to generally recognized performance standards, guidelines, and design criteria. During project appraisal the following environmental and social issues were analyzed: (1) legislation, (2) reduction in air emissions (Kyoto Protocol and carbon credits), (3) water resource management and water quality, (4) soil, forests, and fauna, (5) construction, (6) social issues, and (7) occupational health, workplace safety, and labor issues.

**Environmental Issues:** Small-scale hydropower plants such as Hidroabanico, fed by diversion channels along a river bank, have limited environmental impact and are easier and safer to operate than plants that require a dam or a reservoir to store water. Hidroabanico does not require a dam and will not necessitate relocating people or property. Overall, the Project is compatible with the biophysical, socioeconomic, and cultural environment of the location.

(1) Legislation: Under Ecuador's environmental regulations, projects with potential environmental impact must be reviewed by the environmental authorities in order to obtain the environmental license required to start operations (articles 19 and 20 of the environmental management act Ley de Gestión Ambiental).

Under Article 10 (c) of the environmental regulations for the power sector, the Ministerio del Ambiente (department of the environment) grants environmental licenses for power generation, transmission, and distribution projects whose Definitive Environmental Impact Assessments (DEIA) have been reviewed and approved by the energy authority Consejo Nacional de Electricidad (CONELEC). CONELEC is the agency that oversees the power sector and is part of Ecuador's decentralized environmental management system.

In compliance with the provisions of Ecuador's environmental laws that apply to the power sector, Corbantrade Cia. Ltda. prepared the Definitive Environmental Impact Assessment for the Abanico hydropower project. The assessment was carried out by a local, multidisciplinary consulting group with experience and knowledge of the ecological, socioeconomic, and cultural features of the tropical Amazon rainforest.

The DEIA was approved by CONELEC and the Ministerio del Ambiente. The preliminary environmental impact assessment followed the recommendations made by the Ministerio del Ambiente. The recommendations consisted of filing an additional study on aquatic macroinvertebrates in the stream systems involved in the Abanico hydropower project. According to the study, in the stream systems affected by the project there are no species of economic value to the area's inhabitants. Corbantrade Cia. Ltda. was also asked to hold environmental management plan compliance insurance that takes effect when construction on the hydropower plant begins. The Abanico hydropower plant has a budget for the environmental management plan.

The DEIA and the environmental management plan for building and operating the hydropower plant were approved by CONELEC in January 2004 and by the Ministerio del Ambiente in March 2004, and approval was ratified in June 2004 once the Ministerio del Ambiente's recommendations were satisfactorily implemented.

Once the environmental license for building and operating the hydropower plant is obtained--all that remains is for Corbantrade Cia. Ltda. to pay the requisite fees--Corbantrade will transfer the environmental license to Hidroabanico S.A. According to the Ministerio del Ambiente official in charge of reviewing the project, this is a valid transaction.

The process for obtaining an environmental license for the transmission line will begin soon. This

process involves applying for an extension of the environmental license granted for building and operating the hydropower plant or drafting and filing an environmental impact assessment (EIA) for the transmission line. The Ministerio del Ambiente's official in charge of reviewing the project confirmed that processing the extension would take some two months and the EIA would take approximately four months. The IIC will require Hidroabanico to regularize and complete the process for obtaining the permits for building and operating the hydropower plant and transmission line.

Public Disclosure: Article 88 of the Constitución Política de la República de Ecuador (Ecuador's constitution) provides for a public disclosure process as a way to receive public input on work and project implementation. Under Article 29 of the environmental management act, individuals and bodies corporate are entitled to timely and adequate information on any activity that could have an environmental impact. To make the community aware of the Project, the inhabitants of the area directly affected by the Project were consulted regarding the Abanico river hydropower project impact assessment and environmental management plan on December 27, 2003. The public disclosure meeting in the town of Macas was convened by the company with the support of the municipal authorities and the local parish priest by means of radio announcements, pamphlets, and announcements during religious services.

The community approves of the project because the water that will be discharged into the Balaquepe River after leaving the hydropower plant will supply the town of Macas. The Project will take water from the Abanico River at 1,540 meters above sea level and discharge it at a lower elevation (940 meters above sea level), where it will be available as a water supply for the inhabitants. There is currently a water shortage in the area, and the town does not have the resources to pay for the construction work to bring water from the Abanico River to the Balaquepe River. The municipal authorities therefore support the Project. For this reason, the inhabitants of nearby villages and the town of Macas see the project as favorable and having a positive impact.

(2) Reduction of Air Emissions (Kyoto Protocol and carbon credits): The power generated by the Project will displace approximately 615,000 tons of carbon dioxide (CO<sub>2</sub>) equivalent per year (greenhouse gas emissions). The World Bank Carbon Finance Unit is reviewing the purchase of carbon credits for the Abanico project. The IIC and the World Bank Carbon Finance Unit have worked together closely on this and have shared information to assess the project and evaluate the possibility of the World Bank's making the emission reduction payment to an account established by Hidroabanico to service the IIC loan or directly to an IIC account outside Ecuador.

The Kyoto Protocol (KP) to the United Nations Framework Convention on Climate Change (UNFCCC) seeks to limit greenhouse gas emissions (GGE) and establishes quantified emission limitation and reduction commitments, chiefly for industrialized countries. It also establishes three instruments for meeting these obligations: clean development facility (CDF), joint implementation, and emissions trading. The CDF is of particular interest to Ecuador.

Participation in the CDF requires ratification of the KP and designation of a national authority for the clean development facility (NA-CDF). Ecuador ratified the KP and designated the Ministerio del Ambiente as the NA-CDF and so may participate in the initiative. The types of CDF projects to be considered are: reduction of greenhouse gas emissions, forestation and reforestation, and small-scale greenhouse gas emission projects.

From the environmental viewpoint, the Government of Ecuador has considered measures favoring the development of hydropower as the cleanest available alternative. In this context, small-scale projects like Hidroabanico have priority in the licensing process. The company has procedures for selling carbon credits and has yet to define the procedure for obtaining the letter of support or

approval for the project from the Ministerio del Ambiente.

(3) Water Resource Management and Water Quality: The Project harnesses the hydropower potential of the upper watershed of the stream system in the Abanico-Upano-Namangoza-Santiago-Amazon hydrographical basin. The Project's hydrographical basin is regarded as an ecosystem in which flow depends on rainfall. Mist in the upper watershed condenses with the help of bush vegetation.

Hydrological studies clearly show that flow from the source (Abanico River) is available for the Hidroabanico project. The flow required for the Project is far lower than the minimum flow (ecological flow) required to preserve aquatic species in the Abanico River. This means that diverting flow from the Abanico River for the Project (intake) is compatible with the natural balance of the area and does not affect river health or ecology downstream.

As a result, in October 2003 Corbantrade Cia. Ltda. applied for and obtained the flow concession for the project for a renewable ten-year period granted by the water authority (Agencia de Aguas de Cuenca).

According to the DEIA, the quality of the water leaving the hydropower plant will not change in a way that would require treatment. The water will be discharged into the Balaquepe River just as it leaves the hydropower plant. Nevertheless, the water might be subject to temporary pollution by sewage during plant construction and operation. To prevent this impact, liquid effluents from the workers' camp during plant construction will be disposed of in keeping with environmental regulations. Sewage from the plant's bathrooms will be treated in septic tanks. Effluents from these treatment systems will be monitored by regular sampling to check quality.

Powerhouse equipment will be maintained and monitored regularly to avoid the risk of the turbined water being polluted by leaking oil or fluids that could be hazardous for the environment or the inhabitants of the area, because the turbined water from the plant will be discharged into the same area of the river where drinking water for the inhabitants of Macas is drawn.

The IIC will require, among other things, that the company install oil separation and collection systems in the powerhouse to keep leaks from polluting the Balaquepe River or the groundwater.

(4) Soil, Forests, and Fauna: The Project is located in a tropical rainforest ecosystem in which there are some farms, communities, and, to a lesser extent, tourism. In the past, some tree species (canelo and tagua) were felled by hand for their wood, and land has been used for cattle grazing. There is an area of intervened forest, and replacement of bush vegetation with pastureland is a reflection of anthropogenic activity.

The area directly affected by the Project is a 100-meter wide corridor (50 meters on each side of the penstock axis and the perimeter of the planned civil works). The area indirectly affected has been only slightly or not at all intervened and is near the construction areas. Most of the area of influence is pastureland, with some areas showing regrowth, secondary forest, and remnants of old growth forest. Most of these areas are not easily reached by domesticated animals. Most of the transmission line area of influence runs along a road, so the ecological impact is expected to be minimal and will be defined while the environmental license for the transmission line is being processed. The IIC will require that Hidroabanico obtain a license for the transmission line.

The EIA found signs (tracks, dens, pieces of fruit) of very few mammals, and no species were observed directly. Nevertheless, it is known that the portion of old growth forest in the high part of the watershed is a habitat for animals known by their common names of tigrillo, guatusa, and

squirrel. Few birds were seen, but they were of significant species, such as hummingbirds, sparrows, blue and white swallows, and black turkey buzzards, among others. No evidence of reptiles was found, but several arachnid and butterfly species were observed.

The remnants of old growth forest near the project are very important because they are potentially a refuge for animal species that might be displaced from the project area by noise and human activity. Hunting and fishing in the area should be monitored. The IIC will require that the old growth forest area near the project be monitored constantly to determine the impact of the hydropower plant.

Expected project impacts include temporary changes in river beds and banks, soil and plant cover removal, soil erosion and compaction, and changes to the subsoil during the construction phase.

Nevertheless, the hydrological studies carried out by Hidroabanico show that the Abanico River basin is a mountainous area with a very low population density of less than 1 inhabitant per square kilometer and no villages. The main population centers towards the eastern periphery, with some 30,000 inhabitants in all, are a few towns, the largest of which are Macas and General Proaño. The water taken for the project will therefore not affect water used for human consumption.

In order to mitigate the impact on soil and the forest, Hidroabanico will carry out a revegetation and reforestation program to recover the area's natural vegetation; this will be part of the corrective measures to be taken under the environmental management plan approved by the Ministerio del Ambiente. The IIC will also require that the company ensure that erosion control measures be taken as needed during construction in order to avoid negative impacts on water quality.

During preparation of the EIA, the environmental authorities visited the project area as part of their process for reviewing and ruling on the EIA filed by Hidroabanico. They resolved that the area is not subject to environmental protection. The Ministerio del Ambiente official in charge of the project confirmed this during the IIC appraisal mission.

(5) Construction: Intake and Pipeline Work: The intake work consists of diverting part of the Abanico River to feed the hydropower plant. While building the diversion channel, both the normal flow of the river and the potential for floods that could inundate the area and delay the work or lead to cost overruns should be borne in mind. The IIC's consultant for this project feels that the geotechnical and geophysical parameters required for design and construction were taken into consideration under a research and analysis program that is in line with standard engineering practices for projects like Hidroabanico.

Although the water pipeline leading to the plant crosses a geological fault (Yunguilla fault) and the soil along several stretches is relatively unstable, the consultant considers that the project design and construction calculations include appropriate seismicity considerations and geotechnical estimates. Nevertheless, their recommendations include: (a) having a resident geological engineer as a member of the construction and follow-up team, especially for the excavation work; (b) putting a geologist in charge of inspecting and overseeing the builder; and (c) ensuring that builder has enough experience, especially with intake and pipeline projects. The report from the IIC's consultant contains more detailed information.

Turbined Water Discharge: Several alternatives were analyzed, and the most viable turned out to be doing the civil works necessary for discharging the turbined water into the Balaquepe River. The DEIA stresses the discharge of turbined water, because five cubic meters per second will be transferred to another hydrographical basin. This necessitated planning and designing hydraulic works as required to prevent problems downstream from the discharge point.

Access roads to the project area: The hydropower project location generally lacks adequate roads to the town of Macas and from Macas to the Abanico River area (twenty-one kilometers from the center of town). Most of the roads are earthen and become extremely muddy when it rains, as it does frequently. Only the town of Macas has a basic road infrastructure, made chiefly of paving stones with some stretches of asphalt. The municipal authorities are widening and paving the secondary road from Macas to Riobamba that leads to the project. But some 600 meters of temporary and permanent access roads must be built and kept in good condition.

Archeological Remains: There is no evidence of areas of potential archeological interest in the project area because no archeological studies have been carried out; however, archeological remains might be affected because some inhabitants have mentioned that there might be some. The Definitive Environmental Impact Assessment (DEIA) approved by the Ministerio del Ambiente calls for an archeological and paleontological study before construction work begins in areas where there might be archeological remains.

Solid Waste Disposal: While the hydropower plant is under construction, the construction company will dispose of construction debris and refuse from the construction workers' camp. The debris will be used for building and maintaining the temporary and permanent access roads.

Air Emissions: The machinery and equipment used during the construction phase temporarily emit polluting gases such as sulfur oxides, carbon monoxide, and nitrogen oxides. The construction machinery and equipment will also emit noise.

The company has prepared health, environmental, safety, security and community relations guidelines for the construction contractor to follow. The guidelines are included as an appendix to the service agreement (EPC contract) to be signed with the contractor. The company will supervise the contractor's work, and the IIC will require compliance with the guidelines and applicable IIC standards.

(6) Human Settlements and Social Issues: The socioeconomic area of influence is mainly an indirect area of influence including the Abanico River watershed. During the visit sporadic settlements were observed along the roads leading to the project. The dwellings are simple wood buildings. There are few inhabitants, and none were observed near the Abanico River intake site nor in the powerhouse area where the hydropower plant will be located.

According to the DEIA, in the area of influence of the project there are no highly socially sensitive communities, such as indigenous communities. The closest indigenous community is far from the Abanico hydropower project and is neither directly nor indirectly affected, as could be seen during the IIC's appraisal mission.

Acquisition of Land: The company will have to purchase land from owners living outside the town of Macas, mainly in Quito, Riobamba, and Cuenca. These owners usually lease their land to local tenant farmers until the latter change their activity and the land ceases to be of economic use. According to the client, legalizing the purchase with a notary would take no more than one month, and purchasing the land could even be made a condition for disbursement in order to ensure completion of the process.

(7) Occupational Health, Workplace Safety, and Labor Issues: Hidroabanico S.A. is a new company established to execute the Abanico hydropower project. Hidroabanico was legally established in October 2003; nineteen people will be hired during the operating phase. The company has prepared a complete training program that includes good workplace health and safety practices.

The company will execute the project under an engineering and construction services agreement (EPC contract) to be signed with an Ecuadorian company that will be selected by competitive bidding.

Hidroabanico has prepared health, environmental, safety, security, and community relations guidelines pursuant to the minimum standards of quality required by Ecuadorian law, and occupational health, workplace safety, and environmental protection guidelines and regulations that the project contractor must follow. The guidelines are included in the service agreement (EPC contract) and cover: safe handling of chemicals and risk reporting; response to emergencies such as fire, spills, leaks, and floods; handling of waste; training in fighting fire and handling oil spills; first aid; industrial hygiene; use of personal protection equipment; natural dangers in the form of poisonous plants and animals; and construction safety, among other considerations. The company and the contractors must at all times comply with Ecuadorian labor legislation, and the IIC will require compliance with international labor standards to its own satisfaction.

**Oversight and Compliance:** The company will be required to implement an environmental management plan acceptable to the IIC. The plan will be followed during project construction and operation. The environmental management plan will include at least the issues mentioned in this summary. Throughout the project, the IIC will ensure compliance with its own environmental and labor review policies, review the monitoring reports that the company submits regularly, and make field visits as part of the project supervision process.

#### [Environmental Impact Assessment](#)